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Condensed films obtained from highly ionized C_{60} molecular beam

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Structure of films obtained by condensation from a beam of C_{60} ions and neutral molecules has been studied. The ionization degree in the beam exceeded 90 %. It has been shown that at ion energies of several hundreds eV and the substrate temperature 473 K, *fcc* C_{60} crystals embedded in amorphous matrix containing also diamond and graphite nanocrystals are present in the film. Increase of the beam mean energy results in reduced amount of *fcc* C_{60} phase and increased one of the diamond nanocrystal phase. The substrate temperature elevation up to 673 K results in this case in increased size and amount of nanocrystals having graphite structure.

Исследована структура пленок, полученных конденсацией из пучка ионов и нейтральных молекул C_{60}. Степень ионизации пучка превышала 90 %. Показано, что при энергиях ионов соответствующих сотням эВ и температуре подложки 473 K в пленках присутствуют ГЦК кристаллы C_{60}, расположенные в аморфной матрице, содержащей дополнительно нанокристаллы алмаза и графита. Повышение средней энергии пучка приводит к уменьшению количества ГЦК фазы C_{60} и увеличению количества нанокристаллической алмазной фазы. Повышение температуры подложки до 673 K при этом приводит к росту размера и количества нанокристаллов со структурой графита.

The interest in film carbon objects is supported by the set of properties inherent in its different modifications, such as diamond, graphite, solid amorphous carbon, and molecular cluster crystals. Differences in conditions at the growth surface, the energy and composition of the carbon-containing substance to be condensed favor formation of films distinct considerably in their properties. The deposition from pure carbon flow is known to result in condensate structures ranging from graphite-like ones with sp^2 bindings (at thermal energy of condensing atoms) up to hard diamond-like condensates with sp^3 bindings (deposited from accelerated ionic and atomic carbon beams). The optimum energy values for the hard diamond-like film formation are within the range of 20 to 500 eV per carbon atom [1]; this fact stimulates the wide use of ion-beam and ion-plasma methods to deposit hard carbon coatings.

A relatively novel way to obtain a flow of high-energy carbon-containing substance particles consists in ionization and acceleration of multiatomic carbon clusters [2]. Fullerenes are materials of highest promise for ion-cluster method of film formation due to their easy evaporation and ionization. When hitting a surface, C_{60} molecules of several tens eV energy are not decomposed, so that fullerene films grow. Within that energy range, changes in the film epitaxy and crystal structure are possible as well as growth of non-equilibrium phases [3]. Further acceleration of the ionized mo-